IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of

Applicants : G. Sandhu et al.
Serial No. : 09/998,073
Filed : November 30, 2001
Title : METHOD AND SYSTEM PROVIDING HIGH FLUX OF POINT OF USE ACTIVATED REACTIVE SPECIES FOR SEMICONDUCTOR PROCESSING
Docket No. : MIO 0084 PA
Examiner : G. Winter
Art Unit : 1746
Confirm. No. : 4531

CERTIFICATE OF MAILING
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William A. Jivden, Esq. 42,695 Reg. No.

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Sir:

BRIEF ON APPEAL

This is an appeal from the Office Action mailed on August 7, 2003, finally rejecting claims 46-69. A Notice of Appeal was timely filed on September 22, 2003. A payment for $330.00 accompanies this Brief. 37 CFR §1.17(c).

Real Party In Interest

The real party in interest is the assignee of this patent application, Micron Technology, Inc., by assignment from the named inventors, which assignment has been recorded.

Related Appeals and Interferences

Applicants know of no related appeals or interferences which would affect the outcome of the present appeal.

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Status of Claims

Claims 46-58, 60-69 are present in this patent application. Claims 1-45 and 59 were cancelled. Accordingly, claims 46-58, 60-69 are before this Board on appeal. A correct copy of the appealed claims appears as an Appendix to this Brief.

Claims 46-58, 60-69 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,669,979 to Elliot et al.

Claims 62-63 and 66-68 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of the previous claim. Applicants request that the objections be held in abeyance until allowable subject matter is indicated.

Status of Amendments

An amendment after final rejection was filed on August 29, 2003, proposing amendments to the claims. In the Advisory Action mailed September 11, 2003, the Examiner indicated that the proposed amendments would not be entered as they were not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal. However, an amendment after final rejection has been filed with this appeal brief to correct grammatical and typographical errors noted. No new matter has been entered. Accordingly, the claims in the Appendix to this brief reflect the requested amendments filed herewith.

Summary of the Invention

Applicants' invention is directed a system for chemically treating a surface of a workpiece. As described in the Background section of the specification, problems that exist in processing semiconductor substrates with reactive species are that activated gaseous reactive species have very short lifetimes, and prior art

systems do not provide maximum laser beam energy at the point of use (page 2, para. 0005).

The present invention addresses the above mentioned problems by providing a system 14 which is adapted to generate a high flux of point of use activated reactive species for semiconductor processing (FIG. 2). As illustrated by FIG. 1, a workpiece 4 is exposed to a gaseous atmosphere containing a transmission gas 10 that is substantially nonattenuating to preselected wavelengths of electromagnetic radiation (pg. 6, para. 0021). A laminar flow of a gaseous constituent 12 is also provided over a substantially planar surface 2 of the workpiece 4 wherein a beam of the electromagnetic radiation 8 is directed into the gaseous atmosphere such that it converges in the laminar flow to provide maximum beam energy in close proximity to the surface of the workpiece, but spaced a finite distance H therefrom (pg. 6, para. 0021). The gaseous constituent is dissociated by the beam producing a high flux of activated reactive species 6 at the point of use, which reacts with the surface 2 of the workpiece 4 (pg. 6, para. 0022).

Issues Presented

The issue presented for review on appeal is:

(1) Did the Examiner err in rejecting claims 46-58, 60-69 under 35 U.S.C. § 102(b) as being anticipated by Elliot et al. (U.S. Pat. No. 5,669,979)?

To arrive at a conclusion on the above issue, the Board must also address the following issue:

(2) Has the Examiner carried his burden of establishing a *prima facie* case by showing that the cited reference teach or suggest all the claimed limitations?

Grouping of Claims:

The Examiner has rejected claims 46-58, 60-69 under 35 U.S.C. § 102(b) as being anticipated by Elliot et al.

The application contains 2 rejected independent claims, namely, claims 46 and 64. Applicants submit that these claims do not stand or fall together. The patentability of each independent claim will be separately argued.

The Reference

Elliot et al. (U.S. Pat. No. 5,669,979) teach a method of cleaning a substrate surface, the cleaning being done photoreactively without damaging the surface. A laser beam of UV radiation is delivered at an acute angle to the surface of the substrate, the beam striking the surface at a long and narrow reaction region. The beam and the substrate are moved relative to one another to cause the beam to sweep the surface. While the beam is sweeping the surface, a flow of a reactant gas is provided at the reaction region so that the gas is excited by the UV laser beam. The acute angle of the beam is of a value such that foreign material is removed without essentially damaging the surface of the substrate or leaving a residue that would inhibit further processing of the substrate surface (abstract, emphasis added).

Elliot et al. disclose that the process aspects to be controlled include the form of the delivered energy (e.g., laser radiation possibly augmented by acoustic energy or plasma discharge), the way the energy is delivered (angle of incidence of the energy beam, energy density and distribution, wavelength distribution, shape and dimension of the irradiated region of foreign material, beam pulse rate), the input fluid (composition, temperature, velocity, flow volume, angle of delivery, delivery location, gas pressure), the removal of the cloud (entraining gas flow,

vacuum exhaust), and the reaction conditions (submerged reactions; substrate pretreatment; reaction chamber conditions; substrate temperature; input fluid temperature, pressure, and velocity; number of scans and pattern of scanning; catalysts (col. 6, lines 12-26).

The spatial characteristics (shape and dimension, energy density profile, wavelength distribution) of the laser beam pulses illuminating the foreign material may be selected to enhance the reaction between the ablation components and the reactive species in the input gas (col. 9, lines 23-27).

The most straightforward way of using this beam is to deliver the beam directly from the laser source to the substrate surface or to use one or two spherical lenses or mirrors to form a magnified or demagnified image of the beam at the substrate surface (col. 9, lines 47-52).

Summary of the Argument

Elliot et al. do not disclose the claimed invention to establish a case of anticipation.

ARGUMENT

A. Independent Claims 46 and 64 are not anticipated.

A prior art reference anticipates the subject of a claim when the reference discloses every feature of the claimed invention, either explicitly or inherently (see *Hazani v. Int'l Trade Comm'n*, 126 F.3d 1473, 1477, 44 USPQ2d 1358,1361 (Fed. Cir. 1997) and *RCA Corp. v. Applied Digital Data Systems, Inc.*, 730 F.2d 1440, 1444, 221 USPQ 385, 388 (Fed.Cir. 1984)); however, the law of anticipation does not require that the reference teach what the appellant is claiming, but only that the claims on appeal "read on" something disclosed in the reference (see *Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 772, 218 USPQ 781, 789 (Fed. Cir. 1983), cert. denied, 465 U.S. 1026 (1984)).

Independent claim 46 on appeal includes the limitation of "a source of electromagnetic radiation adapted to converge a beam produced thereby in said flow in close proximity to the surface of the workpiece, but spaced a finite distance therefrom, to dissociate said gaseous constituent to produce a high flux of activated reactive species that chemically treats said surface of said workpiece."

Independent claim 64 on appeal includes the limitation of "an electromagnetic radiation source configured such that upon operation of said electromagnetic radiation source, a beam produced thereby converges in said second region in close proximity to, but not on, said workpiece surface to dissociate said gaseous constituent into an activated species that chemically reacts with said workpiece surface."

In Paper No. 7, the Examiner states that "[a]s an initial matter, the claims are drawn to a "system". A "system" is an "apparatus." See Ex parte Alfred A. Fressola 27 USPQ2d 1608, citing In re Walters, 618 F. 2d 758, 762 n. 2, 205 USPQ 397, 402 n.2 (CCPA 1980). As such, only structural limitations, or structural imparting functions are construed to properly limit the claims." It is with that interpretation of the law, that the applicants believe that the examiner's anticipation rejection of independent claim 46 is founded on ignoring the functional language "adapted to converge a beam produced thereby in said flow in close proximity to the surface of the workpiece, but spaced a finite distance therefrom, to dissociate said gaseous constituent to produce a high flux of activated reactive species that chemically treats said surface of said workpiece." Additionally, applicants believe that the examiner's anticipation rejection of independent claim 64 is founded on ignoring the functional language "configured such that upon operation of said electromagnetic radiation source, a beam produced thereby converges in said second region in close proximity to, but not on, said workpiece surface to dissociate said gaseous constituent into an activated species that

chemically reacts with said workpiece surface." Applicants submit that such constitutes reversible legal error.

There is nothing inherently wrong with defining some part of an invention in functional terms. A functional limitation defines something by what it does, rather than by what it is (e.g., as evidenced by its specific structure or specific ingredients). Functional language does not, in and of itself, render a claim improper. See *In re Swinehart*, 439 F.2d 210, 169 USPQ 226 (CCPA 1971). A functional limitation must be evaluated and considered, just like any other limitation of the claim, for what it fairly conveys to a person of ordinary skill in the pertinent art in the context in which it is used. A functional limitation is often used in association with an element, ingredient, or step of a process to define a particular capability or purpose that is served by the recited element, ingredient or step. See MPEP 2173.05(g).

The Federal Circuit has stated that functional language constitutes "an additional limitation in the claim." *K-2 Corp. v. Salomon S.A.*, 191 F.3d 1356, 52 USPQ2d 1001, 1004 (Fed. Cir. 1999)(citing *Wright Med. Tech. , Inc. v. Osteonics Corp.*, 122 F.3d 1440, 1443-44, 43 USPQ2d 1837, 1840 (Fed. Cir. 1997)(functional language analyzed as a claim limitation). Applicants submit that *In re Venezia*, 530 F. 2d 956, 189 USPQ 149 (CCPA 1976)(functional language...cannot be disregarded) is directly on point and controls in this situation.

The claim language "adapted to converge a beam produced thereby in said flow in close proximity to the surface of the workpiece, but spaced a finite distance therefrom, to dissociate said gaseous constituent to produce a high flux of activated reactive species that chemically treats said surface of said workpiece" and "configured such that upon operation of said electromagnetic radiation source, a beam produced thereby converges in said second region in close proximity to, but not on, said workpiece surface to dissociate said gaseous constituent into an activated species that chemically reacts with said workpiece surface," taken in the

context of the specification and the common knowledge of artisans in the field of chemically treating workpieces with electromagnetic radiation has a clear meaning as to establish the scope of the claims. As well stated by the court in Venezia, such functional language, "[r]ather than being a mere direction of activities to take place in the future,...imparts a structural limitation to the sleeve."

Applicants note that nowhere in the disclosure of Elliot et al. is there any teaching that the beam should be adapted or configured such that it "converges...in close proximity to, but not on, said workpiece" as recited in claims 46 and 64. In fact, the examiner states in Paper No. 7 in regards to Elliot et al., that "[t]he beam is shown to converge at the workpiece see element 416." (Page 5, paragraph 18, line 6). Thus, Elliot et al. teach away from the present invention. Because all the limitations of claims are not disclosed in Elliot et al. for the reasons stated above, the decision of the examiner in rejecting claims 46-58, and 60-69 under 35 U.S.C. § 102(b) should be reversed.

B. Dependent Claims 47-58, 60-63, and 65-69 are not anticipated.

Claims 47-58, 60-63, and 65-69 depend directly or indirectly from independent claims 46 and 64. For the reasons noted above, Elliot et al. do not teach or suggest the features recited in claims 46 and 64. Specifically, the structural imparting functions of the source of electromagnetic energy being adapted or configured to converge the beam in close proximity to, but not on, the workpiece are neither disclosed nor suggested by Elliot et al. Therefore, claims 47-58, 60-63, and 65-69 also are not anticipated by Elliot et al.

CONCLUSION

For all of these reasons, Applicants submit that the rejection is not well taken and should be reversed in its entirety by this Board.

Respectfully submitted,

Dinsmore & Shohl LLP

By _____

William A. Jividen, Esq.
Registration No. 42,695

One Dayton Centre
One South Main Street, Suite 500
Dayton, Ohio 45402-2023
(937) 223-2050
Facsimile: (937) 223-0724
E-mail: william.jividen@dinslaw.com

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APPENDIX

CLAIMS ON APPEAL

46. A system for chemically treating a surface of a workpiece comprising:

a supply of a transmission gas which is substantially nonattenuating to preselected wavelengths of electromagnetic radiation produced by said system;

a supply of a gaseous constituent;

an inlet structure for exposing the workpiece to a controlled gaseous atmosphere containing said transmission gas and for providing a flow of said gaseous constituent to the surface of said workpiece; and

a source of electromagnetic radiation adapted to converge a beam produced thereby in said flow in close proximity to the surface of the workpiece, but spaced a finite distance therefrom, to dissociate said gaseous constituent to produce a high flux of activated reactive species that chemically treats said surface of said workpiece.

47. The system of claim 46 further comprising optics to focus said beam.

48. The system of claim 46 further comprising a structure for causing relative motion between said surface and said beam.

49. The system of claim 46 further comprising a chamber for containing said workpiece and said gaseous atmosphere during said processing, said chamber having a window transparent to said electromagnetic radiation.

50. The system of claim 46 wherein said source of electromagnetic radiation ~~is~~ produces ultraviolet radiation.

51. The system of claim 47, wherein said optics further expand a cross sectional dimension of said beam such that said beam convergence into a wide scanning beam.

52. The system of claim 46 wherein said finite distance is between approximately two and four millimeters above said surface of said workpiece.

53. The system of claim 49 wherein said chamber further comprising an exhaust pump for exhausting gas from said chamber.

54. The system of claim 46 wherein said inlet structure further comprises a nozzle connected to said supply of gaseous constituent to provide a laminar flow across the surface of the workpiece.

55. The system of claim 49 wherein said chamber further comprises a heater for heating the workpiece.

56. The system of claim 49 wherein said chamber further includes a workpiece temperature sensor for measuring the temperature of the workpiece during processing; a pressure sensor for measuring the pressure of gaseous atmosphere in the chamber during processing, and a gas sensor for monitoring the gaseous activated reactive species present in said flow.

57. The system of claim 46 further comprising a supply of a conditioning gas for modifying the chemical reaction between said activated reactive species and said surface of said workpiece, and a mixing chamber for mixing together said gas constituent and said conditioning gas.

58. The system of claim 57 wherein said supply of conditioning gas is selected from the group consisting of accelerant supply and decelerant supply.

60. The system of claim 48 wherein said structure further includes a holder for holding said substrate during said processing.

61. The system of claim 46 wherein said inlet structure is configured to provide the flow of gaseous constituent over the surface of the workpiece in the form of layer having a thickness of less than about 10mm.

62. The system of claim 46 wherein said inlet structure is configured to provide the flow of gaseous constituent over the surface of the workpiece in the form of a layer having a thickness that is at least large enough to accommodate said finite distance.

63. The system of claim 46 wherein said inlet structure is configured such that said transmission gas occupies a majority of said gaseous atmosphere and said flow of gaseous constituent is provided over the surface of the workpiece in the form of a layer occupying a minority of said gaseous atmosphere.

64. A system for treating a surface of a workpiece with electromagnetic radiation, said system comprising:

a first gas source configured to provide a transmission gas defined by a first radiation absorption coefficient;

a second gas source configured to provide a gaseous constituent defined by a second radiation absorption coefficient such that said gaseous constituent is more absorptive of said electromagnetic radiation than said transmission gas;

a chamber comprising:

a workpiece-containing portion; and

an inlet configured to establish fluid communication between said first and second gas sources and said chamber such that a gaseous atmosphere is defined therein, said gaseous atmosphere comprising a first region spaced from said workpiece surface and configured to accept said transmission gas, and a second region disposed between said first region and said workpiece surface and configured to accept said gaseous constituent; and

an electromagnetic radiation source configured such that upon operation of said electromagnetic radiation source, a beam produced thereby converges in said second region in close proximity to, but not on, said workpiece surface to dissociate said gaseous constituent into an activated species that chemically reacts with said workpiece surface.

65. The system of claim 64 wherein said inlet is configured such that during operation of said system, flow of said transmission gas and said gaseous constituent in said first and second regions is laminar.

66. The system of claim 64 wherein said first gas source is configured to supply gas selected from the group consisting of helium, neon, argon, nitrogen and combinations thereof.

67. The system of claim 64 wherein said second gas source is configured to supply gas selected from the group consisting of O_2, O_3, CCl_4, BCl_3, CDF_3, CF_4, SiH_4, $CFCl_3$, F_2CO, $(FCO)_2$, SF_5NF_2, N_2F_4, CF_3Br, CF_3NO, $(CF_3)_2CO$, CF_2HCl, CF_2HBr, CF_2Cl_2, CF_2Br_2, CF_2CFCl, CF_2CFH, $CF_2CF_2CH_2$, NH_3, CHF_3, fluorohalides, halocarbons and combinations thereof.

68. The system of claim 64 wherein said electromagnetic radiation is of a predetermined wavelength.

69. The system of claim 68 wherein said predetermined wavelength is between approximately 190 and 250 nanometers.